ASTRO-AID

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

BUREAU OF LAND MANAGEMENT
SERVICE CENTER
DENVER FEDERAL CENTER, BUILDING 50
P.O. BOX 25047
DENVER, COLORADO 80225-0047

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To: All State Directors

From: Service Center Director

Subject: Astronomical Observations and Ephemerides Information

The two attachments, Astro Aid and The Ephemerides. Application for Computers and Instruments were written, compiled, and prepared by Ray Harpin, retired Land Surveyor who works part time with the Branch of Cadastral Survey Development. Ray collected and researched this data over a period of several years and spent a few days finalizing it at the SC in order to share it with you.

Please note in particular that Ray has identified the location of ASTRO ROM storage registers for specific bits of data (pp. 2 and 3) and he emphasizes day time stellar observations on page 10.

Ray is only infrequently at the SC office; however if you have any questions or comments please leave a message at FTS 236-0191 and he will get back to you.

DSCD, Administration and Technical Services
ACTING

2 Attachments
1 - Astro-Aid (20 pp)
2 - The Ephemerides (4 pp)

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PREFACE

Much of the work done today by land surveyors involves retracement or dependent resurveys through timber and undergrowth. Chapter 6-15 of the Manual of Surveying Instructions, 1973, states "the position of a tract of land, described by legal subdivisions, is absolutely fixed by the original corners and other evidences of the original survey and not by occupation or improvements, or by the lines of a resurvey which do not follow the original". Accurate data collecting is very important because it affects rights and titles of an individual. Chapter 5 of the Manual addresses the use of line trees, blazed true lines and the proper use of topography calls.

Land surveying requires reasonable accuracy at a reasonable cost. The direction of lines is referred to true north at the place of the survey. An instrument is needed that can perform well without having to depend upon references in azimuth, and without having to run a backsight line if there are trees, tall undergrowth, short sights, or other obstructions. Under these conditions, if accuracy is to be maintained, much time is consumed by the field party.

Chapter 3-129 of the Manual specifies the limits of closure and makes provisions that more strict limits of closure may be specified in the Special Instructions 'where higher precision is warranted by values involved. Special Surveys, Townsites, and Mineral Surveys have higher limits that the rectangular system.

It appears that a large tolerance exists for the direction of lines, and direction specifications may or may not be in harmony with distance specifications. We could specify the tolerance for direction of lines as follows:

10"	1/20,000	1' 00"	1/3,333
15"	1/13,333	1' 30"	1/2,300
30"	1/6,667		

The direction accuracy or tolerance of a survey with specifications of 1 min. could have 1.54 ft. error per mile (sin 1' x 5280). To maintain values as good as those required in the direction the maximum error allowed in distance is (5280/3,333) 1.58 ft.

The Manual of 1890 prohibited the use of the magnetic needle except in subdividing of townships and meandering, and then only in areas free from local attraction. The Manual of 1984 eliminated the compass from Public Land Surveys. The solar compass and the solar transit was used extensively to cut costs and time without undue sacrifice of accuracy.

The solar transit consisted of a transit with a solar unit attached. This unit was a second instrument which required constant checks and adjustments. It was a mechanical means of determining the true meridian utilizing the altitude method. Using 20 to 30 setups per mile with no opening of a backsight line, a net result of a mile was 1 min. and 30 secs. Compensated differences are considered.

In conformity with the National Environmental Policy Act of 1969, the operational need for the marking of lines should be weighed against possible aesthetic damage. This may restrict the blazing and marking of true lines but it should not prevent the collecting of data along the original lines. Rights and titles may be affected.

With the advent of the programmable computer, the accurate quartz watch, and the "time kube" the hour angle method of azimuth determination is more widely used. The theodolites of 28 to 32 power telescopes enable the present day surveyor to observe certain stars and planets throughout the day. The hour angle method extends observations of the sun from sun-up to sun-down, or simply stated in another manner, on the horizon or on the meridian and all times between. The altitude method, horizon or on the meridian and all times between. The altitude method, either by direct observation or with the solar unit, was restricted to 15 degrees above the horizon or 1 hour either side of meridian passage.

In all conditions where the solar units were used, one direct observation may now be made with the theodolite. With the instrument in proper adjustment, accurate time, a programmable computer, solar filter, and geographic position known within 20 seconds of arc. Under these conditions a reverse telescope sighting would not be necessary. A reverse sighting was not used with the solar transit. Reading of the vertical arc and comparing it with the computed value would assure correct data input for the computer. It only involves the tracking of the sun or other celestial body to the moment of time of the calculation with data entered by a recorder while the instrument man is setting up.

The ASTRO*ROM and the user manual provides instruction, illustrations, and examples for its use. It is designed to compute certain information with various options.

The Bureau of Land Management Ephemeris has been discontinued. It contained ephemeral data that was useful to the surveyor and the ASTRO*ROM does not provide complete ephemeral data.

Additional ephemeris data may be generated by utilizing certain data as stored in the storage registers. Computations may be made to determine:

Sun's meridian passage
Equation of time
Polaris upper and lower culmination
East and West elongation
Transit time of stars

This additional ephemeral data, with the display results from the program computations, will provide all or most of the information as published in the BLM ephemeris and the nautical almanac. The BLM ephemeris published transit time for stars, other than polaris, to one-tenth minute, or a time within 3 seconds only. This does not provide sufficient accuracy for the hour angle method, but posed no problem for the altitude method. This ASTRO*ROM program provides sufficient accuracy for the hour angle method of azimuth determination.

The GHA of Aries is also computed and provides the data necessary for orientation of the star finder.

The data contained in this report is not intended to establish accuracy specifications for a survey or to re-write the user manual for the ASTRO*ROM. It is only intended to emphasize an operating technique for azimuth determination and to illustrate methods to obtain additional ephemeral data.

DERIVATIVE OF CERTAIN CONSTANTS

To convert a given interval of mean solar time to sidereal time and vice versa:

365.24222 solar days
366.24222 sidereal days

366.24222/365.24222 = 1.00273791

1.00273791/366.24222 = 9.8565 secs. per each mean solar hour .00273791 h

9.8565 x 24 = 236.555 secs. or 03 min. 56.555 secs. per day .06570982 d

GHA ♈ PER HOUR

1.00273791 x 15 = 15° 02′ 27.85″ 15.04106859°

Sidereal day = 24h - Oh 03m 56.5553s = 23h 56m 03.4447s = 23.93429019

SHA = The angle between the hour circle of aries and the hour circle of the body measured westward

GHA★ = GHA ♈ + SHA (apply 360° if necessary)

STORAGE REGISTERS

Appendix E of the user manual lists contents of certain registers. Other data may be of interest and additional contents are tabulated as follows:

R04 GMT
R17 SHA CHS if negative
R20 declination
R21 Pertains to vertical (uncorrected?)
R22 Azimuth
R24 LHA
R27 GHA Aries
R28 GHA
R29 thru R32 Star Coordinates
R33 Latitude
R34 Longitude
R36 Date

ABBREVIATIONS

λ	lambda	The lower case (λ) designates the Longitude of a place, point, or Great Circle Arc.
φ	phi	(fee) The lower case (φ) is used to designate the Latitude of a station or a line parallel to the equator.
♈	Upsilon	Hour circle of First Point of Aries
decl.		Declination
E		East and Elongation
Eq, T.		Equation of Time
GMT		Greenwich Mean Time
GHA		Greenwich Hour Angle
GST		Greenwich Sidereal Time
H.A.		Hour Angle
LMT		Local Mean Time
lat.		Latitude
L.C.		Lower Culmination
LHA		Local Hour Angle
long.		Longitude
N		North
RA		Right Ascension
SHA		Sidereal Hour Angle
UC		Upper Culmination (time of transit)
W		West

TIME

DUT1	Difference in tenths of seconds between UTC and UT1.	
Eq. T.	Equation of Time	if (-) mean sun fast (+) mean sun slow
UT	Universal Time	
UT1	Actual rotation of the earth. UTC + DUT1 (replaces old, ambiguous GMT.)	
UTC	Coordinated Universal Time (Broadcast by the N.I.S.T., formerly the National Bureau of Standards.)	
GMT	Greenwich Mean Time (may be regarded as the general equivalent of UT)	

The difference between UTC and UT1 arises because the time argument depends on the variable rate of rotation of the earth while the broadcast time signals are now based on an atomic time-scale.

The time correction, DUT1, may be obtained from the time signal broadcast UTC. See Annex I, II, and III.

ACCURACIES

An error in time, latitude, and longitude introduce errors in azimuth.

An error in longitude is synonymous with time and both should be as accurate as practical. An error of one second of time could introduce a third order error in itself.

An error of latitude would cause the greatest error 2 to 4 hours from local noon. No azimuth error would result on the meridian.

A difference between a true geodetic azimuth and an observed astronomic azimuth may be distinguished. The difference, resulting from the local deflection of the vertical at the station, is too slight to be of much, if any, significance with respect to the surveyors theodolite. The largest difference in the United States would probably be in the mountainous areas.

ADJUSTING TIME TO UT1

Appendix 1 of the user manual gives information on setting UT1 in the time module. Using T + X is also explained in the HP 41 owners manual.

SUN

Situation 6, page 46 computes ephemeris data for the sun and stars. It does not compute the equation of time or meridian passage. The data necessary to compute this data is stored in the registers.

Using the program EP, the equation of time could be computed for 0 hours Greenwich meridian.

180 - GHA (R28) = Eq. of time	If neg., subt. from apparent time. If pos., add to apparent time.

The equation of time may also be obtained at Greenwich noon using the sun program, utilizing certain options as follows:

ASTRO		decl.	R20
SNO,PL1,ST2	option 0	GHA	R27 noon
		GHA	R28 noon
TMO,UT1,EP2	1	date	R36

Lat.	immaterial
Long.	
SD?1,0,-1	0
UT=SWO?	0
BS?	0
FS?	0
SW?	12 noon

Sun (cont'd)

The following computation is for May 31, 1989, 12 noon Greenwich.

Rcl 28 = 0.59707/15 = 0.03980 HMS = 02m 23.3 sec. = eq. of time

Register 28 contains the GHA for apparent noon Greenwich. If small, that is, 0° to 5° the equation of time is to be subtracted from apparent time to obtain greenwich meridian passage.

If GHA (R28) is near 360° the eq. of time is to be added to apparent time to obtain Greenwich meridian passage. To compute the eq. of time subtract GHA (R28) from 360° divide by 15, HMS to obtain min. and secs.

See Illustration I

To obtain eq. of time for your meridian, enter latitude and longitude of your position. Convert your longitude to time and enter GMT for program prompt SW?. To obtain eq. of time use your LHA in R24 and divide by 15.

If negative, subt. from Local Mean Time for mer. pass.
If positive, add to Local Mean Time for mer. pass.

To state the eq. of time correctly, you must reverse the signs as seen in R24. Correctly stated (-) mean sun fast, (+) mean sun slow

The following is an example of the equation of time determination.

Date: May 31, 1989
Time: 19:30 GMT
Lat. 39° 43' 06"
Long. 112° 30' W.

$\frac{112.5}{15}$ = 7.5 hrs. or 7h 30m. + 12 = 19h 30m + DUT1 (UT1) (time entry)

RCL 24 = -0.58544/15 = 0.03903 (HMS) = - 0h 02m 20.5 sec.

Watch time on the 105 meridian 12h 00m 00.0 sec. (+ DUT1)

Diff. in time of Long. W.		+ 30m 00.0 sec.
		12h 30m 00.0 sec.
Eq. of time (R24 neg)	-	02m 20.5 sec.
		12h 27m 39.5 sec. = watch time of mer. pass.

See Illustration 4

POLARIS

Certain data pertaining to polaris may be obtained by manipulating information stored in the registers. Once upper culmination has been computed, lower culmination and elongation may be determined.

Sidereal Hour Angle (SHA)

SHA = GHA - GHA♈ (if negative, add 360°)
SHA = 360° - RA

GMT R04
RA R19
GHA♈ R27
GHA R28
DECL. R20

Upper Culmination (UC)

360 - GHA = angle until transit
divide by 15 = sidereal time until transit
sid. time x .00273791 = sidereal conversion
sid. time - sid. conv. = solar time until transit
GMT + time until transit = U.C. of polaris (GM) If larger than 24 subt. 24 and UC is for following day.

Apply 23h 56m 03.4447 sec. to change UC 1 day.
Apply 11h 58m 01.7224 sec. o obtain LC.

The following program may be used and the options are selected as follows:

ASTRO
PL1
UT1
LAT observers latitude (to be used to compute elongation)
LONG observers longitude (not used for UC determination)
M.DY? per your selection
UT-SWO? 0 you will use UT1 later
BS 0
FS 0
SW? use UT1 (the time of day is immaterial)

This program will make computations and the data in the storage registers may be used to obtain information as described.

Using the Program for polaris, EP, (ephemeris) situation 6, page 46 of the user manual, upper culmination may also be computed in the same manner. Your latitude for computation of elongation is not stored. The latitude of the observers meridian should be placed using decimal of degrees in register 33.

To determine time of UC of polaris on the observers meridian the longitude must be converted to time, divide by 15, and then multiply by the factor .00273791. Subtract the result from UC of the GM. The time east or west of the meridian the watch is set on must be applied. That is 4 minutes for each degree of longitude.

Polaris (cont'd)

Time of elongation varies with change of latitude. On the equator, elongation would be one-fourth of a sidereal day, or 5h 59m 00.9sec, applied to time of UC. The time of elongation, measured from UC, will decrease as the latitude increases. The formula for computing the time of elongation is:

$$\cos t = \tan\phi \cot\delta$$

This formula computes the hour angle at the greatest elongation in degrees. Divide by 15 to obtain sidereal time, then subtract sidereal conversion which is obtained by multiplying by .00273791.

The following computations were made from program, Polaris, (EP)

```
      Date  05.311989
      360
    - 213.72813  R28
      146.27186 / 15 = 9.75146 x .00273791 = .02670

      9.75146
    -  .02670 sid. conv.
      9.72476  HMS = 9h 43m 29.1 sec. UC Greenwich Meridian (GM)
```

The following computations are for elongation using above data and latitude of 50° 01′ N.

```
      tan φ  50.01667 = 1.19246 R33
      cot δ  89.21539 =x .01119 R20
                          .01334 = cos t = 89.23538°

      89.23538°  = 5.94903 x .00273791 = .01629
         15

      5.94903
    -  .01629
      5.93274  HMS = 5h 55m 57.9sec. = time to be applied to UC.

      UC = 9h 43m 29.1 sec.                 9h 43m 29.1 sec.
           5h 55m 57.1 sec.                 5h 55m 57.9 sec
          15h 39m 27.0 sec. 5-31-1989       3h 48m 21.2 sec. 5-31-1989
                    WE                                EE
```

See Illustration 2

OTHER STARS

Situation 6, page 46 of the user manual has an example of determining ephemeris data of stars other than polaris. GHA and declination are computed. The meridian passage may be computed from GHA stored in R28.

If the GHA is less than 180, the star is W. of the GM.
If the GHA is greater than 180, the star is E. of the GM.
In either case
360 - GHA (R28) = angle to meridian
divide by 15 to obtain sidereal time to meridian passage
sid. time x .00273791 = sidereal conversion
sid. time - sid. conv. = transit time on GM.

RA = 360° - SHA
SHA = GHA - GHA♈ (If neg., add 360°)

SHA	R19 (CHS) if negative
Declination	R20
GHA	R27
GHA	R28

To determine transit time of observers meridian, longitude must be converted to time. Multiply by .00273791 to obtain sidereal conversion. Subtract from transit time on GM. Apply correction to standard time of 4 minutes per each degree of observers longitude is E. or W. of the meridian watch is set.

The following computations are for Spica, May 31, 1989. The program used was EP. (ephemeris) situation 6, page 46.

```
  360
- 47.30753  GHA  R 28
  312.69247/ 15 = 20.84616 x .00273791 = .05707

  20.84616
-  .05707
  20.78909  HMS = 20h 47m 20.7 sec.
```

See Illustration 3

If UT program has been used in lieu of EP, the computations for transit time would be the same. However, you must add the time in R04. If over 24, subt. 24 from the time and the result is transit time for the following day. Also, if the GHA is less than 180, you would also know the star was W. of the meridian of Greenwich.

One day of each calendar year each star will have a double meridian passage. This happens the day when the transit time of a star is between midnight and 0h 3m 56.555 sec. Then the next passage will be 23h 56m 03.445 secs. later or before midnight the same day.

DAY TIME STELLAR OBSERVATIONS
A TECHNIQUE

An observer that has not seen stars in the day time will experience difficulty in seeing the dimmer stars such as polaris, 2.3, alpharatz, 2.2, or cappella, 0.2. Observations on the brighter stars such as sirius, -1.6 or canopus, -0.9 perhaps should be observed first, then the dimmer ones. It makes a big difference in the ability to see the dimmer stars.

The focus on the instrument is very critical. It should be focused on a far distant point; the moon would be ideal. Once you have the star, sharpen the focus very carefully, then mark the focusing mechanism with a ball point or felt tip pen. This will establish an index for future sightings. Many set-ups are in places where a far distant point is not available and then this index is of the utmost importance. This index will remain constant as long as you do not re-focus on the cross hairs.

Many times you may want to check the azimuth of a line but find the sun is behind brush or a cloud. Turning to a star is quite easy. The stars will only be visible in the center of your telescope, the area within the solar circle or an imaginary circle the stadia marks would scribe. The equatorial stars will be on this circle approximately 1 min and 20 secs. prior to intersection with the center cross. Of course sirius would be visible before rigel, as it is brighter.

If your line is in error of approximately 12 minutes or so, you may not see the star cross through your focused field of view. The path the stars take through your telescope will be much the same as the path of the sun. Of course the circumpolar stars would be on a different path. Knowing the probable location of the star in your focused field of view will allow you to concentrate your search in the area where it will first appear.

The computer programs in the Lietz Observation Handbook and Ephemeris are too limited in application. They do not compute the vertical angle to the celestial bodies. It is necessary for day time observation and would help in night time identification of stars. If the vertical angle was measured and then compared with the computed angle, it would indicate correct data input.

The ephemeral data for the celestial bodies is accurate but a user would probably write his own program to compute the vertical angle.

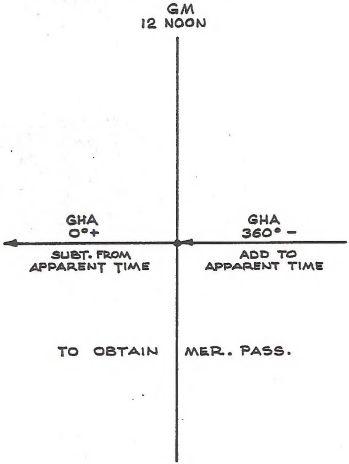

ILLUSTRATION 1

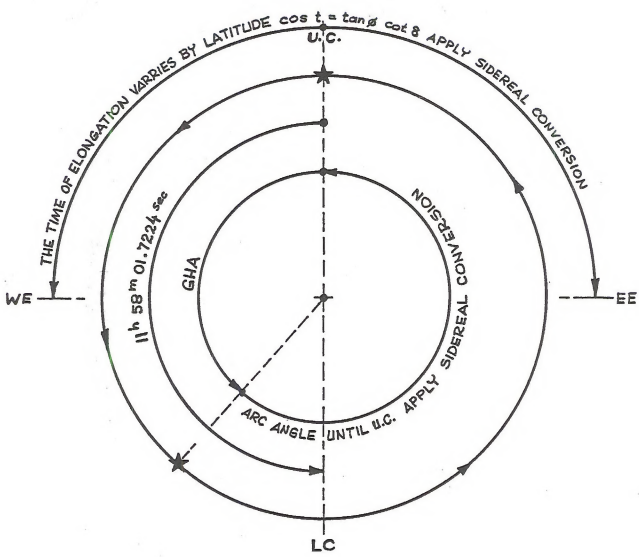

ILLUSTRATION 2

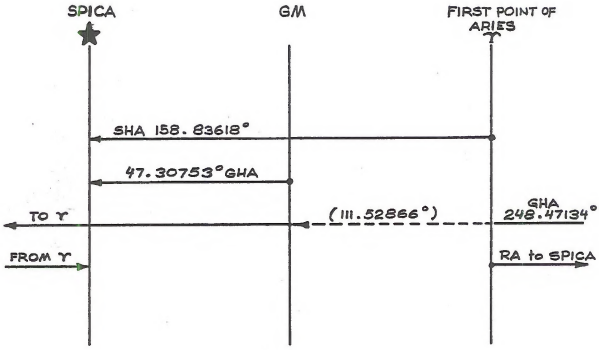

ILLUSTRATION 3

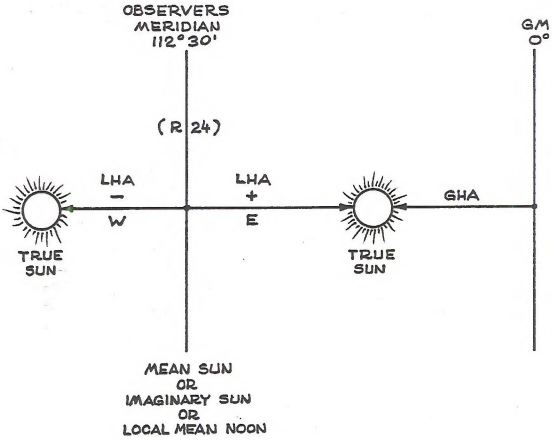

ILLUSTRATION 4

(f) the need to disseminate standard frequencies and time signals in conformity with the second as defined by the 13th General Conference of Weights and Measures (1967);

(g) the continuing need to make Universal Time (UT) inmmediately available to an accuracy of one-tenth of a second,

UNANIMOUSLY RECOMMENDS

1. that all standard-frequency and time-signal emissions conform as closely as possible to Coordinated Universal Time (UTC) (see Annex I); that the time signals should not deviate from UTC by more than one millisecond; that the standard frequencies should not deviate by more than 1 part in 10^{10}, and that the time signals emitted from each transmitting station should bear a known relation to the phase of the carrier;

2. that standard-frequency and time-signal emissions, and other time-signal emissions intended for scientific applications (with the possible exception of those dedicated to special systems) should contain information on the difference between UT1 and UTC (see Annexes I and II);

3. that this document be transmitted by the Director, CCIR, to all Administrations Members of the ITU, to IMCO, ICAO, the CGPM, the BIH, the International Union of Geodesy and Geophysics (IUGG), the International Union of Radio Science (URSI) and the International Astronomical Union (IAU);

4. that the standard-frequency and time-signal emissions should conform to RECOMMENDS 1 and 2 above as from 1 January 1975.

ANNEX I

TIME SCALES

A. Universal Time (UT)

In applications in which an imprecision of a few hundredths of a second cannot be tolerated, it is necessary to specify the form of UT which should be used:

UT0 is the mean solar time of the prime meridian obtained from direct astronomical observation;

UT1 is UT0 corrected for the effects of small movements of the Earth relative to the axis of rotation (polar variation);

UT2 is UT1 corrected for the effects of a small seasonal fluctuation in the rate of rotation of the Earth;

UT1 is used in this document, since it corresponds directly with the angular position of the Earth around its axis of diurnal rotation. (GMT may be regarded as the general equivalent of UT.)

Concise definitions of the above terms and the concepts involved are available in the glossary of the annual publication, *The Astronomical Almanac* (US Government Printing Office, Washington DC and H.M. Stationery Office, London).

B. International Atomic Time (TAI)

The international reference scale of atomic time (TAI), based on the second (SI), as realized at sea level, is formed by the Bureau international de l'heure (BIH) on the basis of clock data supplied by cooperating establishments. It is in the form of a continuous scale, e.g. in days, hours, minutes and seconds from the origin 1 January 1958 (adopted by the CGPM 1971).

C. Coordinated Universal Time (UTC)

UTC is the time-scale maintained by the BIH which forms the basis of a coordinated dissemination of standard frequencies and time signals. It corresponds exactly in rate with TAI but differs from it by an integral number of seconds.

The UTC scale is adjusted by the insertion or deletion of seconds (positive or negative leap-seconds) to ensure approximate agreement with UT1.

D. DUT1

The value of the predicted difference UT1 – UTC, as disseminated with the time signals is denoted DUT1; thus DUT1 ≈ UT1 – UTC. DUT1 may be regarded as a correction to be added to UTC to obtain a better approximation to UT1.

The values of DUT1 are given by the BIH in integral multiples of 0.1 s.

The following operational rules apply:

1. **Tolerances**

1.1 The magnitude of DUT1 should not exceed 0.8 s.

1.2 The departure of UTC from UT1 should not exceed ± 0.9 s. *

1.3 The deviation of (UTC plus DUT1) should not exceed ± 0.1 s.

2. **Leap-seconds**

2.1 A positive or negative leap-second should be the last second of a UTC month, but first preference should be given to the end of December and June, and second preference to the end of March and September.

2.2 A positive leap-second begins at 23h 59m 60s and ends at 0h 0m 0s of the first day of the following month. In the case of a negative leap-second, 23h 59m 58s will be followed one second later by 0h 0m 0s of the first day of the following month (see Annex III).

2.3 The BIH should decide upon and announce the introduction of a leap-second, such an announcement to be made at least eight weeks in advance.

3. **Value of DUT1**

3.1 The BIH is requested to decide upon the value of DUT1 and its date of introduction and to circulate this information one month in advance. **

3.2 Administrations and organizations should use the BIH value of DUT1 for standard-frequency and time-signal emissions, and are requested to circulate the information as widely as possible in periodicals, bulletins, etc.

3.3 Where DUT1 is disseminated by code, the code should be in accordance with the following principles (except § 3.5 below):

- the magnitude of DUT1 is specified by the number of emphasized second markers and the sign of DUT1 is specified by the position of the emphasized second markers with respect to the minute marker. The absence of emphasized markers indicates DUT1 = 0;
- the coded information should be emitted after each identified minute if this is compatible with the format of the emission. Alternatively the coded information should be emitted, as an absolute minimum, after each of the first five identified minutes in each hour.

  Full details of the code are given in Annex II.

3.4 Alternatively, DUT1 may be given by voice or in Morse code.

3.5 DUT1 information primarily designed for, and used with, automatic decoding equipment may follow a different code but should be emitted after each identified minute if this is compatible with the format of the emission. Alternatively, the coded information should be emitted, as an absolute minimum, after each of the first five identified minutes in each hour.

3.6 Other information which may be emitted in that part of the time-signal emission designated in § 3.3 and 3.5 for coded information on DUT1 should be of a sufficiently different format that it will not be confused with DUT1.

3.7 In addition, UT1 – UTC may be given to the same or higher precision by other means, for example, in Morse code or voice, by messages associated with maritime bulletins, weather forecasts, etc.; announcements of forthcoming leap-seconds may also be made by these methods.

3.8 The BIH is requested to continue to publish, in arrears, definitive values of the differences UT1 – UTC, UT2 – UTC.

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* The difference between the maximum value of DUT1 and the maximum departure of UTC from UT1 represents the allowable deviation of (UTC + DUT1) from UT1 and is a safeguard for the BIH against unpredictable changes in the rate of rotation of the Earth.

** In exceptional cases of sudden change in the rate of rotation of the Earth, the BIH may issue a correction not later than two weeks in advance of the date of its introduction.

ANNEX II

CODE FOR THE TRANSMISSION OF DUT1

A positive value of DUT1 will be indicated by emphasizing a number (n) of consecutive second markers following the minute marker from second marker one to second marker (n) inclusive; (n) being an integer from 1 to 8 inclusive.

$$\text{DUT1} = (n \times 0.1)\ \text{s}$$

A negative value of DUT1 will be indicated by emphasizing a number (m) of consecutive second markers following the minute marker from second marker nine to second marker ($8 + m$) inclusive, (m) being an integer from 1 to 8 inclusive.

$$\text{DUT1} = -(m \times 0.1)\ \text{s}$$

A zero value of DUT1 will be indicated by the absence of emphasized second markers.

The appropriate second markers may be emphasized, for example, by lengthening, doubling, splitting or tone modulation of the normal second markers.

Examples:

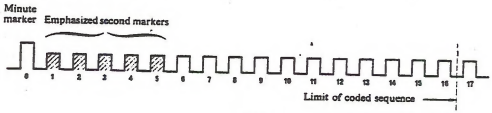

FIGURE 1

DUT1 = +0·5 s

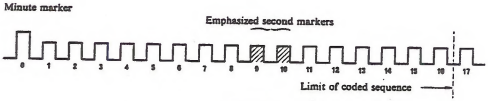

FIGURE 2

DUT1 = −0·2 s

ANNEX III

DATING OF EVENTS IN THE VICINITY OF A LEAP-SECOND

The dating of events in the vicinity of a leap-second shall be effected in the manner indicated in the following figures:

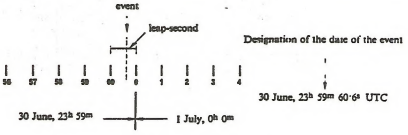

FIGURE 3 – *Positive leap-second*

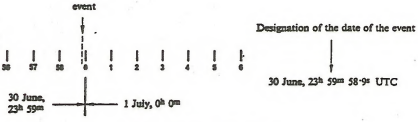

FIGURE 4 – *Negative leap-second*

RECOMMENDATION 535-1 *

USE OF THE TERM UTC

(Question 1/7)

(1978–1982)

The CCIR,

CONSIDERING

(a) that according to Recommendation 460 all standard-frequency and time-signal emissions should conform to the Coordinated Universal Time (UTC);

(b) that since 1972 UTC has been available as a world-wide time reference;

(c) that in 1975 the General Conference of Weights and Measures (CGPM) recommended the use of UTC as the basis of civil time;

(d) that other scientific organizations, particularly the International Astronomical Union (IAU) and the International Union of Radio Science (URSI) have recommended the general use of UTC;

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* The Director, CCIR, is requested to bring this Recommendation to the attention of the Joint Advisory Group of the Institute of Navigation (JAG/ION), the International Astronomical Union (IAU), the International Civil Aviation Organization (ICAO), the Inter-Governmental Maritime Consultative Organization (IMCO) and the World Meteorological Organization (WMO).